Assignment 05
(due on **12/03 19:00**)

PS5_1.R

1. Potential Renewable Energy Spots in China

In this exercise, we will search for some potential renewable energy spots in China. The data sets we will use are GeoTiff (.tif) files provided by the WorldClim.

1.1 [5 points] Download the following data sets and load them in R:

- Solar radiation, 2.5 minutes
- Precipitation, 2.5 minutes
- Wind speed, 2.5 minutes

Answer:

```
#1.1 Read tiff files
#get the 12 layers with different month
dir("wc2.1_2.5m_srad",full.names = T) %>%
  stack() -> worldclimsrad
dir("wc2.1_2.5m_prec",full.names = T) %>%
  stack() -> worldclimprec
dir("wc2.1_2.5m_wind",full.names = T) %>%
  stack() -> worldclimwind
#create a new layer with mean values
Srad_mean <- stackApply(worldclimsrad,indices=c(1),fun=mean,na.rm = TRUE)
Prec_mean <- stackApply(worldclimprec,indices=c(1),fun=mean,na.rm = TRUE)
Wind_mean <- stackApply(worldclimwind,indices=c(1),fun=mean,na.rm = TRUE)
# Look at the raster attributes
Srad_mean
Prec_mean
Wind_mean
```

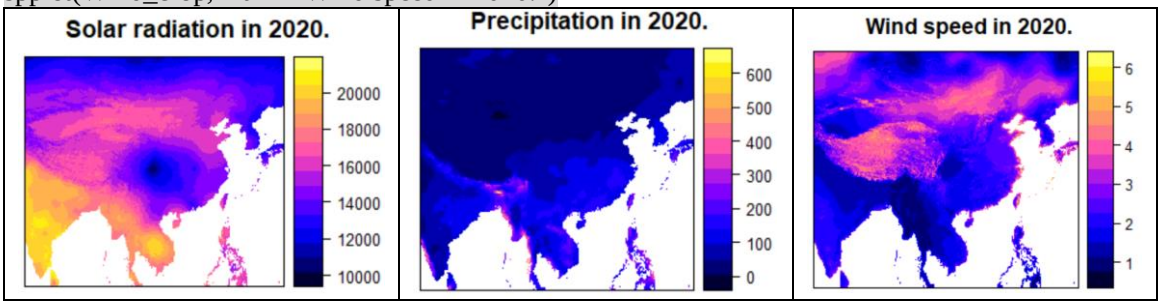
```
> Srad_mean
class      : RasterLayer
dimensions : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution : 0.04166667, 0.04166667  (x, y)
extent     : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs        : +proj=longlat +datum=WGS84 +no_defs
source     : C:/Users/sunshine/AppData/Local/Temp/RtmpecZsg4/raster/r_tmp_2020-11-30_221901_4124_32523.grd
names      : index_1
values     : 0, 23494.25  (min, max)

> Prec_mean
class      : RasterLayer
dimensions : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution : 0.04166667, 0.04166667  (x, y)
```

```
extent     : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs        : +proj=longlat +datum=WGS84 +no_defs
source     : C:/Users/sunshine/AppData/Local/Temp/RtmpecZsg4/raster/r_tmp_2020-11-30_222552_4124_71250.grd
names      : index_1
values     : 0, 937.1667  (min, max)

> Wind_mean
class      : RasterLayer
dimensions : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution : 0.04166667, 0.04166667  (x, y)
extent     : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs        : +proj=longlat +datum=WGS84 +no_defs
source     : C:/Users/sunshine/AppData/Local/Temp/RtmpecZsg4/raster/r_tmp_2020-11-30_224103_4124_00831.grd
names      : index_1
values     : 0.4793333, 19.975  (min, max)
```

1.2 [10 points] Plot the above data sets over China. You should make three plots, each should contain its own legend.

Answer:

```
#1.2Plot the above data sets over China. You should make three plots, each should contain its own legend.
# Read china map, a shape file
China_map_crop <- readOGR("China_map", "bou2_4p")
# Crop the raster with china map
Srad_crop <- crop(Srad_mean, China_map_crop)
Prec_crop <- crop(Prec_mean, China_map_crop)
Wind_crop <- crop(Wind_mean, China_map_crop)

# Plot cropped region
spplot(Srad_crop,main="Solar radiation in 2020.")
spplot(Prec_crop, main="Precipitation in 2020.")
spplot(Wind_crop, main="Wind speed in 2020.")
```

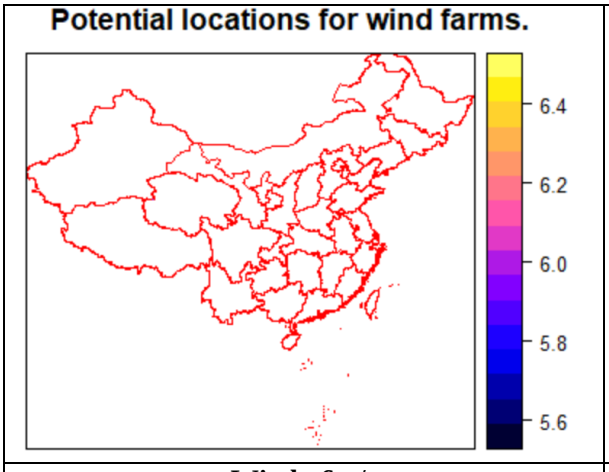


1.3 [5 points] First, let's search for regions with relatively high wind speed to build wind farms. Define a reasonable wind speed as the threshold, and describe your favorite spots.

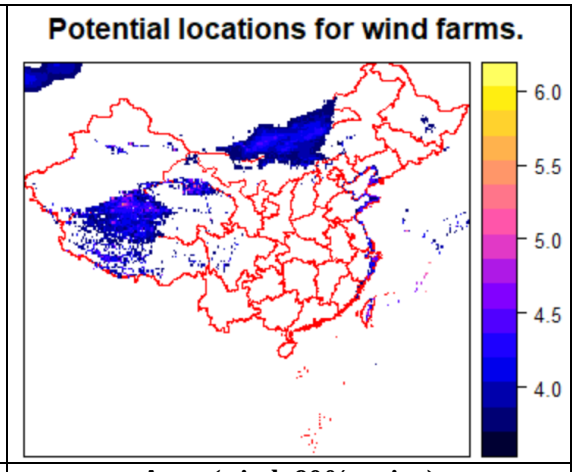
Answer:

```
#1.3 search for regions with relatively high wind speed to build wind farms.
Wind_rc <- reclassify(Wind_crop,c(-Inf,6,NA))
Wind_rc2 <- reclassify(Wind_crop,c(-Inf,quantile(Wind_crop,0.9), NA))
spplot(Wind_rc,
      sp.layout =list("sp.polygons", China_map_crop,col='red',lwd=0.1),,
      main="Potential locations for wind farms.")
spplot(Wind_rc2,
      sp.layout =list("sp.polygons", China_map_crop,col='red',lwd=0.1),
      main="Potential locations for wind farms.")
```

According to the report, generally, the regions to build wind farms, should have an annual average wind speed which is larger than 6m/s. However, according to my plot, we could hardly find the region where the wind mean values larger than 6m/s. So I change the condition to areas(wind>90% region). And from the plot, we can see the feasible regions could be Inner Mongoria、Qinghai、Xinjiang、Tibet and so on.



Wind >6m/s



Areas(wind>90%region)

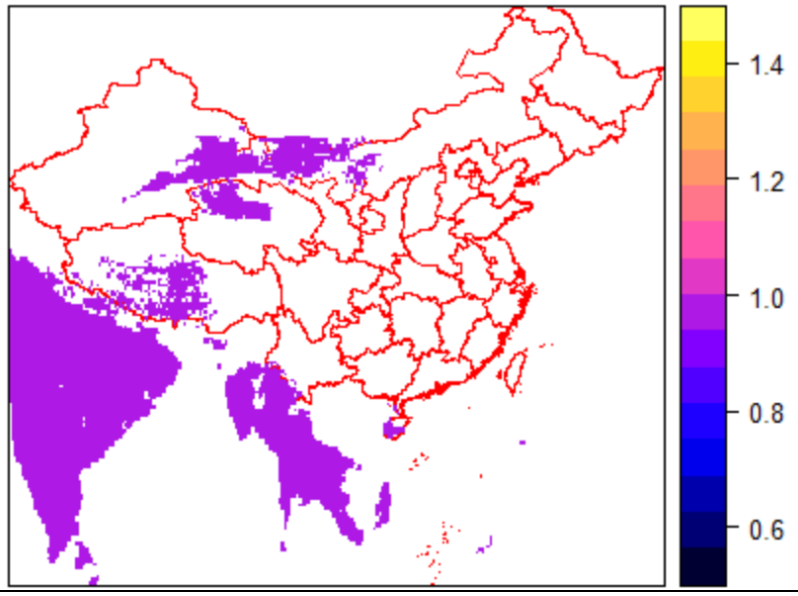
1.4 [5 points] Second, let's search for regions with relatively high solar radiation and low precipitation as potential locations of photovoltaics (PV) farms. Describe your favorite spots of PV farms.

Answer:

```
#1.4 regions with relatively high solar radiation and low precipitation as potential locations of
photovoltaics (PV) farms.
#reclassify the areas(srad>75%)=1,otherwise 0;
#reclassify the areas(prec<75%)=1,otherwise 0;
Srad_rc <- reclassify(Srad_crop,c(-Inf,quantile(Srad_crop,0.75),0,quantile(Srad_crop,0.75),Inf,1))
Prec_rcChina_map_crop <- reclassify(Prec_crop,c(-
Inf,quantile(Prec_crop,0.75),1,quantile(Prec_crop,0.75), Inf, 0))
#get the mean of Srad_rc and Prec_rc
Srad_Prec <- stack(Srad_rc,Prec_rc)
PV_region_test <- stackApply(Srad_Prec,indices=c(1),fun=mean,na.rm = TRUE)
#reclassify the areas(Srad_Prec=1)=1,otherwise NA;
```

```
PV_region <- reclassify(PV_region_test,c(-Inf,0.9,NA))
#plot
spplot(PV_region,
      sp.layout =list("sp.polygons", China_map_crop,col='red',lwd=0.1),
      main="Potential locations for photovoltaics (PV).")
```

As potential locations of photovoltaics (PV) farms should have relatively high solar radiation and low precipitation, we can choose the areas which has a higher solar radiation than the other 75% areas, and has a lower precipitation than the other 75% areas. And from the plot, we can see the feasible regions could be Hainan、Inner Mongoria、Qinghai、Xinjiang、Tibet and so on.



Areas(srad>75% and prec <75% region)

PS5_2.R

2. More Linux Commands

In this exercise, we will learn a few more Linux commands. For each command, please use `man` to learn what it does and how to use it correctly. First, change your directory to `~`.

(In you report, please insert of a screenshot of your Linux code and output. No need to upload R scripts for this exercise.)

2.1 [2 points] Make a link called `data_demo_link` to `data_demo` folder using `ln`

Answer:

```
[ese-suntt@login02 ~]$ pwd
/work/ese-suntt
[ese-suntt@login02 ~]$ man ln
[ese-suntt@login02 ~]$ ll
total 2
drwxr-xr-x 2 root      root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-suntt ese-ouycc 4096 Nov 19 19:37 data_demo
drwxr-xr-x 2 ese-suntt ese-ouycc 4096 Sep 12 11:02 exam
[ese-suntt@login02 ~]$ ln -s data_demo data_demo_link
[ese-suntt@login02 ~]$ ll
total 2
drwxr-xr-x 2 root      root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-suntt ese-ouycc 4096 Nov 19 19:37 data_demo
lrwxrwxrwx 1 ese-suntt ese-ouycc    9 Nov 20 21:40 data_demo_link -> data_demo
drwxr-xr-x 2 ese-suntt ese-ouycc 4096 Sep 12 11:02 exam
```

2.2 [2 points] Go to `data_demo/data/`, make an empty file `planets.txt_1st` with `touch`.

Answer:

```
[ese-suntt@login02 ~]$ man touch
[ese-suntt@login02 ~]$ cd data_demo/data
[ese-suntt@login02 data]$ ll
total 260
-rw-r--r-- 1 ese-suntt ese-ouycc   283 Nov 19 19:17 amino-acids.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 animal-counts
-rw-r--r-- 1 ese-suntt ese-ouycc   136 Nov 19 19:17 animals.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 elements
-rw-r--r-- 1 ese-suntt ese-ouycc     8 Nov 19 19:51 file1
-rw-r--r-- 1 ese-suntt ese-ouycc   554 Nov 19 19:17 morse.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 pdb
-rw-r--r-- 1 ese-suntt ese-ouycc  8898 Nov 19 19:17 planets.txt
-rw-r--r-- 1 ese-suntt ese-ouycc    45 Nov 19 19:17 salmon.txt
-rw-r--r-- 1 ese-suntt ese-ouycc 73861 Nov 19 19:17 sunspot.txt
[ese-suntt@login02 data]$ touch planets.txt_1st
[ese-suntt@login02 data]$ ll
total 260
-rw-r--r-- 1 ese-suntt ese-ouycc   283 Nov 19 19:17 amino-acids.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 animal-counts
-rw-r--r-- 1 ese-suntt ese-ouycc   136 Nov 19 19:17 animals.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 elements
-rw-r--r-- 1 ese-suntt ese-ouycc     8 Nov 19 19:51 file1
-rw-r--r-- 1 ese-suntt ese-ouycc   554 Nov 19 19:17 morse.txt
drwxr-xr-x 2 ese-suntt ese-ouycc  4096 Nov 19 19:17 pdb
-rw-r--r-- 1 ese-suntt ese-ouycc  8898 Nov 19 19:17 planets.txt
-rw-r--r-- 1 ese-suntt ese-ouycc     0 Nov 20 21:48 planets.txt_1st
-rw-r--r-- 1 ese-suntt ese-ouycc    45 Nov 19 19:17 salmon.txt
-rw-r--r-- 1 ese-suntt ese-ouycc 73861 Nov 19 19:17 sunspot.txt
```

2.3 [2 points] Print your home directory using `echo`.

Answer:/work/ese-suntt

```
[ese-suntt@login02 data]$ man echo
[ese-suntt@login02 data]$ echo $HOME
/work/ese-suntt
```

2.4 [3 points] Find how many files in `data_demo/data/pdb/` using `find`.

Answer:49

```
[ese-suntt@login02 data]$ man find
[ese-suntt@login02 data]$ find ./pdb -type f | wc -l
48
[ese-suntt@login02 data]$ find ./pdb | wc -l
49
```

2.5 [3 points] Count how many `C` character appears in `data_demo/data/pdb/tnt.pdb` with `grep`.

Answer:10

```
[ese-suntt@login02 data]$ man grep
[ese-suntt@login02 data]$ grep -o "C" ./pdb/t
testosterone.pdb   thiamine.pdb       tnt.pdb            tuberin.pdb        tyrian-purple.pdb
[ese-suntt@login02 data]$ grep -o "C" ./pdb/tnt.pdb | wc -l
10
```

2.6 [2points]Compare `data_demo/data/pdb/ethane.pdb` and `data_demo/data/pdb/ethanol.pdb` with `diff`

Answer:

```
[ese-suntt@login02 data]$ man diff
[ese-suntt@login02 data]$ cd pdb
[ese-suntt@login02 pdb]$ diff ethane.pdb ethanol.pdb -y
COMPND      ETHANE                                                | COMPND      ETHANOL
AUTHOR      DAVE WOODCOCK  95 12 18                               | AUTHOR      DAVE WOODCOCK  96 01 03
ATOM      1  C           1      -0.752   0.001  -0.141  1.00   | ATOM      1  C           1      -0.426  -0.115  -0.147  1.00
ATOM      2  C           1       0.752  -0.001   0.141  1.00   | ATOM      2  O           1      -0.599   1.244  -0.481  1.00
ATOM      3  H           1      -1.158   0.991   0.070  1.00   | ATOM      3  H           1      -0.750  -0.738  -0.981  1.00
ATOM      4  H           1      -1.240  -0.737   0.496  1.00   | ATOM      4  H           1      -1.022  -0.351   0.735  1.00
ATOM      5  H           1      -0.924  -0.249  -1.188  1.00   | ATOM      5  H           1      -1.642   1.434  -0.689  1.00
ATOM      6  H           1       1.158  -0.991  -0.070  1.00   | ATOM      6  C           1       1.047  -0.383   0.147  1.00
ATOM      7  H           1       0.924   0.249   1.188  1.00   | ATOM      7  H           1       1.370   0.240   0.981  1.00
ATOM      8  H           1       1.240   0.737  -0.496  1.00   | ATOM      8  H           1       1.642  -0.147  -0.735  1.00
TER       9              1                                      | ATOM      9  H           1       1.180  -1.434   0.405  1.00
                                                                > TER      10             1
END                                                               END
```

2.7 [2 points] Check the total file size of the `data_demo` folder using `df`.

Answer:

```
[ese-suntt@login02 data_demo]$ man df
[ese-suntt@login02 data_demo]$ df .
Filesystem         1K-blocks          Used    Available Use% Mounted
work           536911806464 178643156992 358268649472  34% /work
[ese-suntt@login02 data_demo]$ df . -h
Filesystem      Size  Used Avail Use% Mounted on
work            501T  167T  334T  34% /work
```

2.8 [3 points] Copy the `data_demo` folder to `data_demo_new`, compress it using `zip`, and decompress the `.zip` file with `unzip`.

Answer: (1) cp –r data_demo/ data_demo_new
(2) zip -q -r data_demo_new.zip ./data_demo_new
(3) unzip -o -d data_demo_new.zip

```
[ese-suntt@login02 ~]$ mkdir data demo new
[ese-suntt@login02 ~]$ cp -r data_demo/ data_demo_new
[ese-suntt@login02 ~]$ ll
total 3
drwxr-xr-x 2 root      root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-suntt ese-ouycc 4096 Nov 19 19:37 data_demo
lrwxrwxrwx 1 ese-suntt ese-ouycc    9 Nov 20 21:40 data_demo_link -> data_demo
drwxr-xr-x 3 ese-suntt ese-ouycc 4096 Nov 20 23:09 data_demo_new
drwxr-xr-x 2 ese-suntt ese-ouycc 4096 Sep 12 11:02 exam
```

2.9 [3 points] Change the file permissions flags on `data_demo_new` to `drwxr-x---` using `chmod`.

Answer:

```
[ese-suntt@login02 ~]$ man chmod
[ese-suntt@login02 ~]$ chmod 750 data_demo_new
[ese-suntt@login02 ~]$ ll
total 3
drwxr-xr-x 2 root      root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-suntt ese-ouycc 4096 Nov 19 19:37 data_demo
lrwxrwxrwx 1 ese-suntt ese-ouycc    9 Nov 20 21:40 data_demo_link -> data_demo
drwxr-x--- 3 ese-suntt ese-ouycc 4096 Nov 20 23:09 data_demo_new
drwxr-xr-x 2 ese-suntt ese-ouycc 4096 Sep 12 11:02 exam
```

2.10 [3 points] Print the last 10 commands you made using `history`.

Answer:

```
[ese-suntt@login02 ~]$ history 10
  137  ll
  138  man chmod
  139  chmod u=wrx,g=rx data_demo_new
  140  cd data_demo_new
  141  cd ..
  142  ll
  143  man chmod
  144  chmod 750 data_demo_new
  145  ll
  146  history 10
```